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EFFECTS OF CHARCOAL ROT DISEASE CAUSED BY *Macrophomina phaseolina* ON QUALITY OF COTTON FIBERS

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ABSTRACT

Effects of charcoal rot of cotton, caused by *Macrophomina phaseolina*, on fiber quality of 11 commercial cotton cultivars (*Gossypium barbadense*) were evaluated outdoors in a natural clay loam soil. The soil was uninfested or infested with the fungus. At the end of the growing season, lint was obtained and subjected to the following tests: Fiber length at 50% S.L., fiber length at 2.5% S.L., fiber length uniformity ratio (FLUR), strength at zero gauge, strength at 1/8 gauge, fiber strength uniformity ration (FSUR), elongation, stiffness, toughness, micronaire reading, maturity ratio, hair weight, degree of yellowness, reflectance, Congo Red, pH value, and fiber sugar content. Analysis of variance showed that cultivar, treatment, and cultivar x treatment interaction were significant or very highly significant source of variation in almost all the tested properties. Cultivar (genotype) accounted for most of the explained (model) variation in physical and mechanical characters, while treatment (environment) accounted for almost all the explained variation in chemical properties. Due to the significance of cultivar x treatment interaction, an interaction least significant difference was used to compare between means of noninfested and infested soils within cultivars for each of the tested properties. These comparison showed that elongation, FLUR, and FSUR were the least sensitive properties to *M. phaseolina* infection because elongation was not adversely affected in any of the tested cultivars, while FLUR or FSUR were adversely affected in only two cultivars. On the other hand, fiber strength at zero, and chemical properties were the most sensitive properties to *M. phaseolina* infection because fiber strength at zero was adversely affected in 10 cultivars, while any of the chemical properties was adversely affected in all the tested cultivars. The other properties were adversely affected in a number of cultivars ranged from 4 to 10. Giza 76 and Giza 85 were the least susceptible cultivars to deterioration by *M. phaseolina* infection. Thus, Giza 76 was adversely affected in 6 properties, while Giza 85 was adversely affected in 5 properties. On the contrary, Giza 45, Giza 80, Giza 83, Giza 86, and Dendera were the most susceptible cultivars to deterioration because the number of adversely affected properties in these cultivars were 12, 12, 12, 11, and 15, respectively. The number of adversely affected properties of Giza 75, Giza 77, or Giza 84 was 8 and increased to 10 in Giza 70.

INTRODUCTION

Macrophomina phaseolina (Tassi) Goid., the causal agent of charcoal rot on cotton, is a seed-borne and soil-borne pathogen with a wide distribution and wide host range (Dhingra and Sinclair, 1978). When *M. phaseolina* invades roots or stems of cotton, colonization of internal tissues proceeds rapidly and the plant dies. Examination of affected parts reveals a dry rot, with many tiny black sclerotia distributed throughout the wood and softer tissues (Watkins, 1981).

We believe that the importance of *M. phaseolina*, as a cotton pathogen in Egypt, is underestimated. This view has come from the observation that during the last 50 years, *M. phaseolina* on cotton was almost completely absent from the literature of cotton diseases in Egypt. Thus, a handful of research papers, most of them not dealing with *M. phaseolina per se,* were found in this literature (Mostafa *et al.*, 1957; Mostafa, 1959; Mohamed, 1962; Sabet and Khan, 1969; and Omar, 1999). This lack of concern is not justifiable because this fungus is of widespread distribution in the Egyptian soil and it is easily and frequently isolated from cotton roots particularly during the late period of the growing season. Thus, when Aly *et al.* (1996) conducted a survey encompassed 88 samples of infected cotton roots from 12 Egyptian governorates, *M. phaseolina* was isolated from 37.5% of the samples examined.

Since the isolation of *M. phaseolina* from infected cotton roots is more frequent during the late period of the growing season, it is assumed that it may deteriorate the developing fibers. Although such a deterioration has been demonstrated in case of other root-invading fungi like *Fusarium oxysporum* f.sp. *vasinfectum* (Badr, 1980). *Phymatotrichum omnivorum* (Mulrean *et al.*, 1984), and *Verticillium dahliae* (Bell, 1992), it is unclear in case of *M. phaseolina* due to the lack of studies in this area. Therefore, the objective of this study was to determine the effects of *M. phaseolina* on physical, mechanical, and chemical properties of fibers from 11 commercially grown cotton cultivars.

MATERIALS AND METHODS

Preparation of *M. phaseolina* inoculum and infestation of soil with the fungal inoculum

Substrate for growth of a highly pathogenic isolate of *M. phaseolina* was prepared in 500-ml glass bottles, each bottle contained 50 g of sorghum grains and 40 ml of tap water. Contents of each bottle were autoclaved for 30 minutes. Isolate inoculum, taken from one-week-old culture on PDA, was aseptically introduced into the bottle and allowed to colonize sorghum for three weeks. The fungus-sorghum mixture was used to infest a natural clay loam soil at a rate of 40 g/kg soil. Infested soil was dispensed in 30-cm-diameter clay pots. In the control (uninfested) treatments, autoclaved sorghum grains were mixed thoroughly with natural soil at a rate of 40 g/kg soil. In the middle of April, pots were planted with 50 seeds per pot for each of the tested cultivars (Giza 45, Giza 70, Giza 75, Giza 76, Giza 77, Giza 80, Giza 83, Giza 84, Giza 85, Giza 86, and Dendera). There were 5 replicates (pots) for each treatment. The pots were randomly distributed outdoors at Giza Agricultural Research Station. The seedlings were thinned to five per pot 45 days after planting. The recommended production practices for cotton were followed during the growing season. Seedcotton yield (cottonseed and lint before ginning) of fully fluffed bolls of the replicates of each treatment was picked in the middle of October for the following tests, which were carried out after ginning:

Physical and mechanical tests

Fiber length at both 2.5 and 5 % span length (SL) in mm was measured by a fibrograph according to Anonymous, 1984: D 1447-83. Uniformity ratio was calculated according to Sundarm (1979). Micronaire reading was determined according to Anonymous, 1984: D 1448-59. Fiber strength (g/tex) and elongation percent were measured by a stelometer according to Anonymous 1984: D 1445-751. Fiber stiffness and toughness were calculated according to Grover and Hamby (1960).

Color and chemical tests

Color of raw cotton was measured by high volume instrument (HVI) in terms of two color scales: degree of yellowness ($^{+}$b) and reflectance (RD%) according to Anonymous, 1984: D2253-76. The Congo Red test described by Clegg (1940) was used to measure fiber damage index. The pH of an aqueous extract of fiber was measured according to Marsh *et al.* (1951). Reducing sugar content was determine by Soxhlet apparatus according to Smith (1956).

All fiber tests were carried out in laboratories of Cotton Research Institute, Agric. Res. Center, Giza at constant relative humidity of 65±2% and temperature of 70±2°F.

Statistical analysis of the data

The experimental design of all studies was a randomized complete block with five replicates in the outdoor study and three replicates in the laboratory tests of fiber quality. Analysis of variance (ANOVA) of the data was performed with MSTAT-C. Statistical Package (A Microcomputer Program for the Design, Management, and Analysis of Agronomic Research Experiments, Michigan State Univ., USA). Least significant difference (LSD) was used compare isolate means.

RESULTS AND DISCUSSION

ANOVA in Table 1 showed significant or very highly significant effects of cultivar, treatment, and cultivar x treatment interaction on fiber length parameters. Cultivar was the most important source of variation in the tested parameters (Table 2).

Table 1. Analysis of variance of the effects of cotton cultivars, charcoal rot incidence and their interaction on fiber length parameters of cotton cultivars.

Parameter and source of variation [a]	D.F.	M.S.	F. value	P > F
Fiber length at 50%				
Replication	2	0.003	0.2784	
Cultivar (C)	10	8.878	858.6905	0.0000
Treatment (T) [b]	1	1.639	158.5040	0.0000
C x T	10	0.240	23.1923	0.0000
Error	42	0.010		
Fiber length at 2.5%				
Replication	2	0.224	3.6824	0.0336
Cultivar (C)	10	24.221	398.5517	0.0000
Treatment (T)	1	4.276	70.3672	0.0000
C x T	10	0.456	7.5039	0.0000
Error	42	0.061		
Fiber strength uniformity ratio				
Replication	2	0.287	2.0374	0.1431
Cultivar (C)	10	3.435	24.3522	0.0000
Treatment (T)	1	0.601	4.2627	0.0452
C x T	10	0.285	2.0228	0.0550
Error	42	0.141		

[a] Replication is random, while each of cultivar and treatment is fixed.
[b] Natural soil infested and noninfested with *M. phaseolina*.

Table 2. Relative contribution of cotton cultivar, charcoal rot incidence, and their interaction on fiber length parameters of cotton cultivars.

Source of variation	Relative contribution to variation [a] in		
	Fiber length at 50%	Fiber length at 2.5%	Fiber length uniformity ratio
Cultivar (C)	95.60	96.31	89.49
Treatment (T) [b]	1.77	1.70	1.57
C x T	2.58	1.81	7.43

[a] Calculated as percentage of sum squares of the explained (model) variation..
[b] Natural soil infested and noninfested with *M. phaseolina*.

The comparisons between noninfested and infested soil regarding fiber length at 50% within each cultivar showed that infestation of soil significantly decreased the parameters of Giza 45, Giza 77, Giza 83, Giza 84, and Dendera, while the parameters of the remaining cultivars was not affected. (Table 3). Fiber length at 2.5% of Giza 45, Giza 77, Giza 83, and Dendera was significantly reduced by *M. phaseolina*, while the fungus did not affect fiber length at 2.5% of the other cultivars. *M. phaseolina* significantly reduced fiber length uniformity ratio (FLUR) of Giza 83 and Dendera, while this parameters was not affected by *M. phaseolina* in the other cultivars.

Table 3. Effect of *M. phaseolina* on fiber length parameters of cotton cultivars.

Cultivar	Parameters					
	Fiber length at 50% S.L. (mm)		Fiber length at 2.5% S.L. (mm)		Fiber length uniformity ratio (%)	
	Non-infested soil	Infested soil	Non-infested soil	Infested soil	Non-infested soil	Infested soil
Giza 45	16.733	16.133	33.033	32.133	50.633	50.200
Giza 70	17.700	17.700	34.267	34.267	51.600	51.633
Giza 75	15.600	15.600	31.433	31.400	49.633	49.667
Giza 76	17.667	17.700	34.300	34.367	51.233	51.467
Giza 77	17.100	16.767	34.033	33.200	50.133	50.467
Giza 80	14.567	14.500	29.433	29.267	49.500	49.533
Giza 83	15.433	14.633	30.333	29.233	50.867	50.033
Giza 84	17.600	16.967	33.067	33.067	51.833	51.333
Giza 85	14.667	14.533	29.267	29.067	50.100	49.900
Giza 86	15.600	15.733	31.367	31.333	49.733	49.900
Dendera	15.500	14.433	30.633	29.100	50.567	49.600
LSD for cultivar x treatment interaction at:						
P ≤ 0.05	0.165		0.0.407		0.619	
P ≤ 0.01	0.220		0.544		NS	

ANOVA (Table 4) showed very highly significant effects of cultivar and cultivar x treatment interaction on all the mechanical parameters. Treatment was a very highly significant source of variation in all the mechanical parameters except elongation. Cultivar accounted for 56.27% of the explained (model) variation in strength at 1/8 gauge; however, it accounted for almost all the explained (model) variation in all the other parameters (Table 5).

Table 4. Analysis of variance of the effects of cotton cultivar, charcoal rot incidence, and their interaction on mechanical parameters of cotton cultivars.

Parameter and source of variation [a]	D.F.	M.S.	F. value	P > F
Strength at zero gauge				
Replication	2	0.179	3.0951	0.0557
Cultivar (C)	10	120.083	2076.0230	0.0000
Treatment (T) [b]	1	79.508	1374.5553	0.0000
C x T	10	3.061	52.9270	0.0000
Error	42	0.058		
Strength at 1/8				
Replication	2	0.038	0.8341	
Cultivar (C)	10	3.662	79.5931	0.0000
Treatment (T)	1	20.163	438.3071	0.0000
C x T	10	0.822	17.8615	0.0000
Error	42	0.046		
Fiber strength uniformity ratio				
Replication	2	0.025	0.0415	
Cultivar (C)	10	286.020	468.8424	0.0000
Treatment (T)	1	15.915	26.0882	0.0000
C x T	10	10.041	16.4584	0.0000
Error	42	0.610		
Elongation				
Replication	2	0.010	1.4718	0.2411
Cultivar (C)	10	4.719	698.9108	0.0000
Treatment (T)	1	0.000	0.0000	
C x T	10	0.120	17.8052	0.0000
Error	42	0.007		
Stiffness				
Replication	2	153.591	1.8497	0.1699
Cultivar (C)	10	38797.670	467.2428	0.0000
Treatment (T)	1	6500.379	78. 2845	0.0000
C x T	10	1507.112	18.1502	0.0000
Error	42	83.035		
Toughness				
Replication	2	0.000	1.5339	0.2275
Cultivar (C)	10	0.134	442.2368	0.0000
Treatment (T)	1	0.021	68.3961	0.0000
C x T	10	0.003	11.5008	0.0000
Error	42	0.000		

[a] **Replication is random, while each of cultivar and treatment is fixed.**
[b] **Natural soil infested and noninfested with *M. phaseolina*.**

Table 5. Relative contribution of cultivar, charcoal rot incidence, and their interaction to variation in mechanical parameters of cotton cultivars.

	Relative contribution to variation [a] in					
	Strength at zero gauge	Strength at 1/8	Fiber strength uniformity ratio	Elongation	Stiffness	Toughness
Cultivar (C)	91.57	56.27	96.09	97.48	94.66	95.99
Treatment (T) [b]	6.06	30.99	0.54	0.00	1.59	1.50
C x T	2.34	12.63	3.37	2.48	3.68	2.51

[a] Calculated as percentage of sum squares of the explained (model) variation..
[b] Natural soil infested and noninfested with *M. phaseolina*.

Strength at zero gauge of all the tested cultivars, except Giza 85, was significantly reduced by *M. phaseolina* (Table 6). *M. phaseolina* did not significantly affect strength at 1/8 gauge of Giza 76, Giza 84, and Giza 85, whereas it significantly reduced this parameter for all the other cultivars. As to fiber strength uniformity ration (FSUR), the tested cultivars showed variable responses to soil infestation with *M. phaseolina*. Thus, *M. phaseolina* significantly reduced FSUR of Giza 75 and Giza 80, whereas, it significantly increased that of Giza 45, Giza 76, Giza 83, and Giza 84. On the other hand, FSUR of the remaining cultivars was not affected by *M. phaseolina*. Elongation of Giza 45 and Giza 75 was significantly increased in the infested soil, whereas that of Giza 80 was significantly decreased. Infestation of soil did not affect this parameter for the other cultivars. *M. phaseolina* significantly reduced stiffness of Giza 45, Giza 75, and Giza 77, whereas it did not significantly affect stiffness of the other cultivars. Toughness of Giza 45 was significantly increased in infested soil, while toughness of Giza 70, Giza 80, Giza 83, Giza 86, and Dendera was significantly reduced, this parameter was not affected by *M. phaseolina* in the other cultivars.

ANOVA in Table 7 showed very highly significant effects of cultivar, treatments, and cultivar x treatment interaction on all the parameters of fineness maturity, and color. Cultivar was the most important source of variation in the parameters (Table 8).

Table 6. Effect of *M. phaseolina* on mechanical parameters of cotton cultivars.

Cultivar	Parameters											
	Strength at zero gauge (g/tex)		Strength at 1/8 gauge (g/tex)		Fiber strength uniformity ratio		Elongation (%)		Stiffness (g/tex)		Toughness (g/tex)	
	Non-infested soil	Infested soil	Non-infested soil	Infested soil	Non-infested soil	Infested soil	Non-infested soil	Infested soil	Non-infested soil	Infested soil	Non-infested soil	Infested soil
Giza 45	50.753	46.493	36.103	34.557	72.190	74.327	5.730	8.183	630.667	558.667	1.037	1.070
Giza 70	55.487	52.650	34.543	33.437	62.253	63.507	5.390	5.300	641.000	631.333	0.933	0.887
Giza 75	50.893	49.637	34.797	32.383	68.373	65.243	5.797	6.350	600.333	510.333	1.020	1.027
Giza 76	54.147	51.360	33.863	33.687	62.540	65.590	5.787	5.697	585.333	591.667	0.977	0.960
Giza 77	52.753	51.170	35.780	34.777	67.823	67.960	5.107	5.077	700.333	685.000	0.910	0.883
Giza 80	42.280	41.240	34.703	32.777	82.077	79.480	7.660	7.163	453.000	457.667	1.327	1.173
Giza 83	45.197	40.503	34.677	33.463	76.723	82.623	7.340	7.267	472.867	460.333	1.273	1.217
Giza 84	50.720	48.277	34.590	34.277	68.200	70.997	5.393	5.300	641.000	646.667	0.933	0.910
Giza 85	45.383	45.253	33.267	33.233	73.307	74.493	6.037	6.033	551.000	538.667	1.003	1.000
Giza 86	52.390	51.673	33.157	32.270	63.290	62.457	5.640	5.533	588.000	583.333	0.933	0.890
Dendera	43.760	41.360	34.863	33.323	79.667	80.570	7.573	7.550	460.333	441.667	1.320	1.260
LSD for cultivar x treatment interaction at:												
$P \leq 0.05$	0.397		0.353		1.287		0.138		15.01		0.029	
$P \leq 0.01$	0.531		0.473		1.721		0.184		20.07		0.038	

Table 7. Analysis of variance of the effects of cotton cultivar, charcoal incidence, and their interaction on fiber parameters of fineness, maturity, and color of cotton cultivars.

Parameter and source of variation [a]	D.F.	M.S.	F. value	P > F
Micronaire reading				
Replication	2	0.005	0.3863	
Cultivar (C)	10	0.912	75.0118	0.0000
Treatment (T) [b]	1	0.764	62.8256	0.0000
C x T	10	0.078	6.4259	0.0000
Error	42	0.012		
Maturity ratio				
Replication	2	0.000	2.0513	0.1413
Cultivar (C)	10	0.008	73.6609	0.0000
Treatment (T)	1	0.009	89.7850	0.0000
C x T	10	0.001	5.4692	0.0000
Error	42	0.000		
Hair weight				
Replication	2	4.061	4.1382	0.0229
Cultivar (C)	10	954.100	972.3401	0.0000
Treatment (T)	1	872.727	889.4118	0.0000
C x T	10	100.761	102.6869	0.0000
Error	42	0.981		
Degree of yellowness				
Replication	2	0.003	0.0711	
Cultivar (C)	10	16.548	369.6360	0.0000
Treatment (T)	1	12.135	271.0507	0.0000
C x T	10	2.239	50.0203	0.0000
Error	42	0.045		
Reflectance				
Replication	2	0.611	1.2472	0.2977
Cultivar (C)	10	95.826	195.5828	0.0000
Treatment (T)	1	109.470	223.4306	0.0000
C x T	10	11.676	23.8318	0.0000
Error	42	0.490		

[a] Replication is random, while each of cultivar and treatment is fixed.
[b] Natural soil infested and noninfested with *M. phaseolina*.

Table 8. Relative contribution of cultivar, charcoal rot incidence, and their interaction to variation in fiber parameters of fineness, maturity, and color of cotton cultivars.

	Relative contribution to variation [a] in				
	Micronaire reading	Maturity	Hair weight	Degree of Yellowness	Reflectance
Cultivar (C)	85.44	83.52	83.48	82.73	80.82
Treatment	7.16	9.89	7.64	6.07	9.23
C x T	7.32	6.59	8.82	11.20	9.85

[a] Calculated as percentage of sum squares of the explained (model) variation.

All the parameters of Giza 45, and Giza 70, except yellowness, were adversely affected by *M. phaseolina* (Table 9).

Table 9. Effect of *M. phaseolina* on fiber, parameters of fineness, maturity, and color of cotton cultivars.

Cultivar	Parameters									
	Micronaire reading		Maturity ratio (%)		Hair weight (millitex)		Degree of yellowness (+b) %		Reflectance (RD) (%)	
	Non-infested soil	Infested soil	Non-infested soil	Infested soil	Non-infested soil	Infested soil	Non-infested soil	Infested soil	Non-infested soil	Infested soil
Giza 45	3.600	3.300	0.820	0.780	131.000	123.000	9.767	9.967	75.100	71.100
Giza 70	4.400	4.067	0.860	0.810	153.000	146.667	10.000	10.133	72.800	71.033
Giza 75	4.500	4.500	0.830	0.830	161.000	161.000	9.133	10.200	77.033	76.100
Giza 76	3.500	3.500	0.810	0.810	129.000	129.000	8.900	9.600	75.800	74.100
Giza 77	3.800	3.800	0.800	0.790	141.000	141.000	12.500	12.700	68.200	67.400
Giza 80	4.800	4.100	0.790	0.780	174.000	156.000	13.800	14.333	64.400	63.400
Giza 83	3.900	3.900	0.760	0.737	156.000	148.000	12.167	12.433	69.200	67.400
Giza 84	3.700	3.233	0.803	0.763	136.000	129.000	12.700	12.800	67.800	67.133
Giza 85	3.600	3.500	0.773	0.767	136.667	136.000	9.400	9.833	76.200	73.400
Giza 86	4.200	4.000	0.830	0.800	150.000	124.000	9.500	13.800	74.700	64.267
Dendera	3.867	3.600	0.740	0.690	149.000	143.000	11.867	13.367	68.567	66.133
LSD for cultivar x treatment interaction at:										
$P \leq 0.05$	0.181		0.016		1.632		0.350		1.153	
$P \leq 0.01$	0.241		0.022		2.182		0.467		1.542	

M. phaseolina significantly increased yellowness of Giza 75, while none of the other parameters of this cultivar was adversely affected by the fungus.

All the tested parameters of Giza 77 were not adversely affected by *M. phaseolina*. On the other hand, all the parameters of Giza 86 and Dendera were adversely affected by the fungus. In the remaining cultivars, the number of adversely affected parameters ranged from 2 to 3.

Cultivar, treatment, and cultivar x treatment interaction were all very highly significant sources of variation in all the chemical parameters (Table 10). Treatments accounted for almost all the explained (model) variation in chemical parameters (Table 11).

Table 10. Analysis of variance of the effects of cotton cultivar, charcoal rot incidence, and their interaction on fiber chemical parameters of cotton cultivars.

Parameter and source of variation [a]	D.F.	M.S.	F. value	P > F
Congo Red test				
Replication	2	0.060	0.3444	
Cultivar (C)	10	2.544	14.4919	0.0000
Treatment (T) [b]	1	52813.469	300873.3307	0.0000
C x T	10	3.090	17.6017	0.0000
Error	42	0.176		
pH value				
Replication	2	0.002	0.2226	
Cultivar (C)	10	0.066	8.1217	0.0000
Treatment (T)	1	22.810	2792.7789	0.0000
C x T	10	0.100	12.2475	0.0000
Error	42	0.008		
Fiber sugar content				
Replication	2	0.000	0.4655	
Cultivar (C)	10	0.001	6.3072	0.0000
Treatment (T)	1	6.085	35948.9895	0.0000
C x T	10	0.001	3.2852	0.0000
Error	42	0.000		

[a] Replication is random, while each of cultivar and treatment is fixed.
[b] Natural soil infested and noninfested with *M. phaseolina*.

Table 11. Relative contribution of cotton cultivar , charcoal incidence , and their interaction to variation in fiber chemical properties of cotton cultivars.

Source of Variation	Relative contribution to variation [a] in		
	Congo Red test	pH value	Fiber sugar content
Cultivar (C)	0.05	2.71	0.18
Treatment (T) [b]	99.89	93.19	99.74
C x T	0.06	4.09	0.10

[a] Calculated as percentage of sum squares of the explained (model) variation.
[b] Natural soil infested and noninfested with *M. phaseolina*.

Chemical parameters of all the cultivars were adversely affected by *M. phaseolina* in particular Congo Red test (Table 12).

Table 12. Effect of *M. phaseolina* on fiber chemical parameters of cotton cultivars.

Cultivars	Parameter					
	Congo Red		pH value		Fiber sugar content	
	Non-infested soil	Infested soil	Non-infested soil	Infested soil	Non-infested	Infested Soil
Giza 45	7.967	65.333	7.067	8.633	0.323	0.937
Giza 70	8.033	65.333	7.033	8.233	0.303	0.923
Giza 75	8.033	64.333	7.033	8.733	0.300	0.920
Giza 76	8.133	65.567	7.133	8.233	0.313	0.920
Giza 77	8.233	62.667	7.300	8.200	0.327	0.927
Giza 80	8.267	64.200	7.100	8.367	0.327	0.970
Giza 83	8.100	62.667	7.000	8.033	0.303	0.903
Giza 84	8.033	66.733	7.133	8.133	0.340	0.913
Giza 85	8.200	63.200	7.200	8.067	0.313	0.893
Giza 86	8.067	65.333	7.067	8.233	0.307	0.917
Dendera	7.967	66.000	7.167	8.300	0.317	0.930
LSD for cultivar x treatment interaction at:						
$P \leq 0.05$	0.691		0.155		0.023	
$P \leq 0.01$	0.924		0.207		0.031	

Data in Table 13 showed that elongation, FLUR, and FSUR were the least sensitive properties to *M. phaseolina* infection because elongation was not adversely affected in any of the tested cultivars, while FLUR and FSUR were adversely affected in only two cultivars. On the other hand, fiber strength at zero, and chemical properties were the most sensitive properties to *M. phaseolina* infection because fiber strength at zero was adversely affected in 10 cultivars, while any of the chemical properties was adversely affected in all the tested cultivars. The other properties were adversely affected in a number of cultivars ranged from 4 to 10.

Giza 76 and Giza 85 were the least susceptible cultivars to deterioration by *M. phaseolina* infection. Thus, Giza 76 was adversely affected in six properties, while Giza 85 was adversely affected in five properties. On the contrary, Giza 45, Giza 80, Giza 83, Giza 86, and Dendera were the most susceptible cultivars to deterioration because the number of adversely affected properties in these cultivars were 12, 12, 12, 11, and 15, respectively. the number of adversely affected properties of Giza 75, Giza 77, or Giza 84 was 8 and increased to 10 in Giza 70.

Table 13. Summary of effects of *M. phaseolina* on the physical, mechanical, and chemical properties of 11 commercially grown cotton cultivars.

Cultivars	Property				
	Fiber length at 50% S.L. (mm)	Fiber length at 2.5% S.L. (mm)	Fiber length uniformity ratio (%)	Strength at zero gauge (g/tex)	Strength at 1/8 gauge (g/tex)
Giza 45	- **[a]	- **	NS	- **	- **
Giza 70	NS[b]	NS	NS	- **	- **
Giza 75	NS	NS	NS	- **	- **
Giza 76	NS	NS	NS	- **	NS
Giza 77	- **	- **	NS	- **	- **
Giza 80	NS	- **	NS	- **	- **
Giza 83	- **	- **	- *	- **	- **
Giza 84	- **	NS	NS	- **	NS
Giza 85	NS	NS	NS	NS	NS
Giza 86	NS	NS	NS	- **	- **
Dendera	- **	- **	- *	- **	- **

Table 13. Cont.

Cultivars	Property					
	Fiber strength uniformity ration	Elongation (%)	Stiffness (g/tex)	Toughness (g/tex)	Micronaire reading	Maturity ration (%)
Giza 45	+ **[c]	+ **	- **	+ *	- **	- **
Giza 70	NS	NS	NS	- **	- **	- **
Giza 75	- **	+ **	- **	NS	NS	NS
Giza 76	+ **	NS	NS	NS	NS	NS
Giza 77	NS	NS	- *	NS	NS	NS
Giza 80	- **	- **	NS	- **	- **	NS
Giza 83	+ **	NS	NS	- **	NS	- **
Giza 84	+ **	NS	NS	NS	- **	- **
Giza 85	NS	NS	NS	NS	NS	NS
Giza 86	NS	NS	NS	- **	- *	- **
Dendera	NS	NS	- *	- **	- **	- **

Table 13. Cont.

Cultivars	Property					
	Hair weigh (millitex)	Degree of yellowness (+b)	Reflectance (RD) (%)	Congo Red	pH value	Fiber sugar content
Giza 45	- **	NS	- **	+ **	+ **	+ **
Giza 70	- **	NS	- **	+ **	+ **	+ **
Giza 75	NS	+ **	NS	+ **	+ **	+ **
Giza 76	NS	+ **	- **	+ **	+ **	+ **
Giza 77	NS	NS	NS	+ **	+ **	+ **
Giza 80	- **	+ **	NS	+ **	+ **	+ **
Giza 83	- **	NS	- **	+ **	+ **	+ **
Giza 84	- **	NS	NS	+ **	+ **	+ **
Giza 85	NS	+ *	- **	+ **	+ **	+ **
Giza 86	- **	+ **	- **	+ **	+ **	+ **
Dendera	- **	+ **	- **	+ **	+ **	+ **

[a] ***M. phaseolina*** **caused significant decrease at $p < 0.01$ (**) or $p < 0.05$ (*).**

[b] **Effect of *M. phaseolina* was nonsignificant.**

[c] ***M. phaseolina*** **caused significant increase at $p < 0.01$ (**) or $p < 0.05$ (*).**

Modern fiber quality analysis has become more elaborate and sophisticated. The price and marketability of cotton is based on fiber length and strength, thickness, and uniformity of fiber length in the bale. These tests established the economic value of the fiber and the applicability of the fiber for certain types of textile processing (Mulrean *et al.*, 1984).

During harvest, cotton from healthy and *M. phaseolina*-infected plants are mixed. These fibers are further homogenized during ginning and baling. To asses crop losses attributable to *M. phaseolina* in cotton accurately, fiber quality must be considered. In the present study, patterns of changes in most of the testea properties indicated that quality of fibers tended to deteriorate in *M. phaseolina*-infested soil.

Cotton properties are under strict genetic regulation; however, Longenecker and Eric (1969) showed that inadequate moisture during the 50 to 60-day period of fiber maturation could adversely affect lint quality. Therefore, it seems reasonable to assume that the degradation of root by *M. phaseolina* resulted in plant water stress that ultimately reduced fiber quality of *M. phaseolina*-infected plants.

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تأثيرات مرض العفن الفحمى الناجم عن الإصابة بفطر ماكروفومينـــا فاســـيولينا على صفات الجودة في ألياف القطن

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قيم ١١ صنف قطن تجارى – خارج الصوبة – وذلك من حيث تأثيرات مرض العفن الفحمى – الناجم عن الإصابة بفطر ماكروفومينا فاسيولينا – على صفات الجودة فى التيلة. زرعت الأصناف فى تربة طبيعية طينية طمييه غير ملوثة أو ملوثة بالفطر. أجريت على التيلة المتحصل عليها فى نهاية الموسم مجموعة من الإختبارات لتقدير الصفات التالية: طول التيلة عند نسبتى توزيع ٢,٥ و ٥٠% ودرجة إنتظام الطول ومتانة التيلة على مسافتى صفر و ٨/١ بوصة ودرجة إنتظام المتانة ونسبة الإستطالة وصلابة التيلة والقدرة على إمتصاص الجهد وقراءة الميكرونير ودرجة النضج ووزن الشعرة ودرجة الإصفرار ودرجة إنعكاس الضوء ودرجة الضرر ودرجة تركيز أيونات الأيدروجين ونسبة السكريات. كانت الأصناف والمعاملات وتفاعل الأصناف × المعاملات مصادر معنوية أو عالية المعنوية للتباين فى معظم الصفات. معظم التباين المفسر فى الصفات الفيزيائية والميكانيكية كان يعزى إلى تأثير الصنف (التركيب الوراثى) فى حين أن معظم التباين المفسر فى الصفات الكيميائية كان يعزى إلى تأثير المعاملات (البيئة). نظراً لمعنوية تفاعل الأصناف × المعاملات لجميع الصفات موضع الدراسة ، فإن أقل فرق معنوى إستعمل للمقارنة بين تأثير التربة الغير ملوثة وتلك الملوثة بالفطر على صفات الجودة لكل صنف. أظهرت هذه المقارنات أن نسبة الإستطالة ودرجة إنتظام الطول ودرجة إنتظام المتانة كانت أقل الصفات حساسية للإصابة بالفطر نظراً لأن نسبة الإستطالة لم يطرأ عليها تدهور فى أى صنف من الأصناف ، اما درجة إنتظام الطول أو درجة إنتظام المتانة فقد طرأ عليها تدهور فى صنفين فقط. من ناحية أخرى ، يمكن القول بأن متانة التيلة على مسافة صفر والصفات الكيماوية كانت أكثر الصفات حساسية للإصابة بالفطر ، إذ طرأ تدهور على صفة المتانة على مسافة صفر فى ١٠ أصناف ، أما كل صفة من الصفات الكيماوية فقد طرأ عليها تدهور فى جميع الأصناف ، أما الصفات الأخرى فقد طرأ عليها تدهور فى عدد من الأصناف تتراوح ما بين ٤ ألى ١٠. الصنفان جيزة ٧٦ وجيزة ٨٥ كانا أقل الأصناف قابلية للتدهور نتيجة للإصابة بالفطر ، إذ أظهر جيزة ٧٦ تدهوراً فى ٦ صفات ، فى حين أظهر جيزة ٨٥ تدهوراً فى ٥ صفات. على العكس من ذلك ، فإن الأصناف جيزة ٤٥ وجيزة ٨٠ وجيزة٨٣ وجيزة٨٦ ودندرة كانت أكثر الأصناف قابلية للتدهور نتيجة للإصابة بالفطر ، إذ أظهرت تدهوراً فى ١٢ و١٢ و١٢ و١١ و١٥ صفة ، على الترتيب. أظهر كل من جيزة ٧٥ أو جيزة ٧٧ أو جيزة ٨٤ تدهوراً فى ٨ صفات ، أما جيزة ٧٠ فقد أظهر تدهوراً فى ١٠ صفات.